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What is claimed is:

1. Apparatus for estimating the intensities of elements (pels) in a picture in accordance with information defining intensities of pels in preceding and succeeding versions of the picture including means for determining by interpolation intensities of pels in said picture in accordance with intensities of pels in related locations in said preceding and succeeding versions,

10 ~~PO CHARACTERIZED IN THAT~~
said determining means includes means for selecting said related locations as a function of the displacement of objects in said picture.

2. The invention defined in claim 1 wherein said apparatus includes:

15 ~~PO~~ means for storing a present estimate D^i of said displacement, and

~~PO~~ means for recursively updating said estimate for each element in said picture.

3. The invention defined in claim 2 wherein said apparatus includes means for operating said updating means only in moving areas in said picture.

4. The invention defined in claim 3 wherein said apparatus further includes:

25 ~~PO~~ means for computing a frame difference $FD(\underline{x})$ indicating the intensity difference at spatially corresponding locations in preceding and succeeding versions, and

~~PO~~ means for computing a displaced frame difference $[DFD(\underline{x}, \underline{D})]$ indicating the intensity difference at the
30 ~~PO~~ related locations determined by said displacement estimate,

~~PO~~ wherein said selecting means is arranged to select said displaced locations if said displaced frame difference is smaller than said frame difference and to select said corresponding locations otherwise.

35 5. The invention defined in claim 1 wherein said apparatus further includes:

16 means for storing the intensity values for pels in said preceding and succeeding versions, and

13 means responsive to said present displacement estimate for addressing selected ones of said stored
5 values.

6. Apparatus for estimating the intensity values of each element (pel) of a picture being processed by interpolating between the intensity values of related pels in first and second other versions of said picture,
10 including:

13 means for estimating the displacement of objects in said picture occurring between said/other versions, and

13 means for selecting said related/pels in accordance with said displacement estimate.

15 7. The invention defined in claim 6 wherein said
96 first and second other versions occur at intervals $K_1\tau$
L before and $K_2\tau$ after said picture being processed, where K_1
and K_2 are positive integers and τ is a predetermined
constant, and wherein said related pels are at displaced
31, 30 20 locations $\underline{x} - K_1\underline{D}$ and $\underline{x} + K_2\underline{D}$ in said first and second
versions, respectively, where \underline{x} is the vector location of
the pel in said presently processed picture and \underline{D} is the
10 vector representing said displacement estimate per time τ .

8. The invention defined in claim 7 wherein said
25 displacement estimate is recursively updated such that an
update term is added to each estimate to form the next
estimate, where said update term is a function of the
intensity difference at said displaced locations.

9. The invention defined in claim 8 wherein said
30 apparatus further includes means for comparing said
intensity difference at said displaced location with the
intensity difference at the same location \underline{x} in said other
versions, and

13 means for operating said selecting means only if
35 said displaced location intensity difference is smaller
than said same location intensity difference.

10. Apparatus for reducing the bandwidth needed to transmit a video signal representing a sequence of pictures by encoding the intensity values of pels in ones of said pictures in said sequence and reconstructing
5 missing pictures using information from encoded pictures, including:

P_0 means for computing the intensity of pels in a missing picture by interpolating the intensity of pels in corresponding locations in the encoded ones of said
10 pictures which precede and follow said missing picture, and
 P_0 means for selecting said corresponding locations as a function of the displacement of objects in said picture between said preceding and following pictures.

11. The invention defined in claim 10 further
15 including:

P_0 means for storing an estimate D^i of said displacement, and

P_0 means for recursively updating said estimate to form a new estimate D^{i+1} by adding a correction term which
20 is a joint function of (a) the intensity difference at said corresponding location, and (b) the spatial gradient of said intensity difference.

12. The invention defined in claim 11 wherein said apparatus further includes:

25 P_0 means for storing the intensity values of pels in said preceding and following pictures, and

P_0 means for addressing said stored values in accordance with D^i to obtain the intensities at said corresponding locations.

30 13. A method of estimating the intensities of elements (pels) in a picture in accordance with information defining intensities of pels in preceding and succeeding versions of the picture including the step of determining by interpolation intensities of pels in said picture in
35 accordance with intensities of pels in related locations in said preceding and succeeding versions,

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said determining step includes selecting said related locations as a function of the displacement of objects in said picture.

5 14. The method defined in claim 13 further including the steps of:

P₆ storing a present estimate \underline{D}^i of said displacement, and

P₆ recursively updating said estimate for each
10 element in said picture.

15 15. The method defined in claim 14 further including the step of operating said updating means only in moving areas in said picture.

15 16. The method defined in claim 15 further including the steps of:

P₆ computing a frame difference $FD(\underline{x})$ indicating the intensity difference at spatially corresponding locations in preceding and succeeding versions, and

P₆ computing a displaced frame difference $[DFD(\underline{x}, \underline{D})]$
20 indicating the intensity difference at the related locations determined by said displacement estimate,

P₆ wherein said selecting step includes selecting said displaced locations if said displaced frame difference is smaller than said frame difference and selecting said
25 corresponding locations otherwise.

17. The method defined in claim 13 wherein said determining step further includes:

P₆ storing the intensity values for pels in said preceding and succeeding versions, and addressing selected
30 ones of said stored values in response to said present displacement estimate.

18. A method of estimating the intensity values of each element (pel) of a picture being processed by interpolating between the intensity values of related pels
35 in first and second other versions of said picture, including the steps of

estimating the displacement of objects in said picture occurring between said other versions, and

selecting said related pels in accordance with said displacement estimate.

5 19. The method defined in claim 18 wherein said
96 first and second other versions occur at intervals $K_1\tau$
L before and $K_2\tau$ after said picture being processed, where K_1
and K_2 are positive integers and τ is a predetermined
constant, and wherein said related pels are at displaced
31, 42 10 locations $\underline{x} - K_1\underline{D}$ and $\underline{x} + K_2\underline{D}$ in said first and second
versions, respectively, where \underline{x} is the vector location of
96 the pel in said presently processed picture and \underline{D} is the
vector representing said displacement estimate per time τ .

20. The method defined in claim 19 wherein said
15 displacement estimating step includes recursive updating
such that an update term is added to each estimate to form
the next estimate, where said update term is a function of
the intensity difference at said displaced locations.

21. The method defined in claim 20 further
20 including the steps of comparing said intensity difference
at said displaced location with the intensity difference at
the same location \underline{x} in said other versions, and
96 precluding said selecting step if said displaced
location intensity difference is larger than said same
25 location intensity difference.

22. A method of reducing the bandwidth needed to
transmit a video signal representing a sequence of pictures
by encoding the intensity values of pels in ones of said
pictures in said sequence and reconstructing missing
30 pictures using information from encoded pictures,
including:

96 computing the intensity of pels in a missing
picture by interpolating the intensity of pels in
corresponding locations in the encoded ones of said
35 pictures which precede and follow said missing picture, and

P selecting said corresponding locations as a function of the displacement of objects in said picture between said preceding and following pictures.

23. The method defined in claim 22 further including the steps of:

P storing an estimate \underline{D}^i of said displacement, and
L recursively updating said estimate to form a new
90 estimate \underline{D}^{i+1} by adding a correction term which is a joint function of (a) the intensity difference at said
10 corresponding location, and (b) the spatial gradient of said intensity difference.

24. The method defined in claim 23 further including the steps of:

P storing the intensity values of pels in said
15 preceding and following pictures, and
P addressing said stored values in accordance with \underline{D}^i to obtain the intensities at said corresponding locations.

And —————